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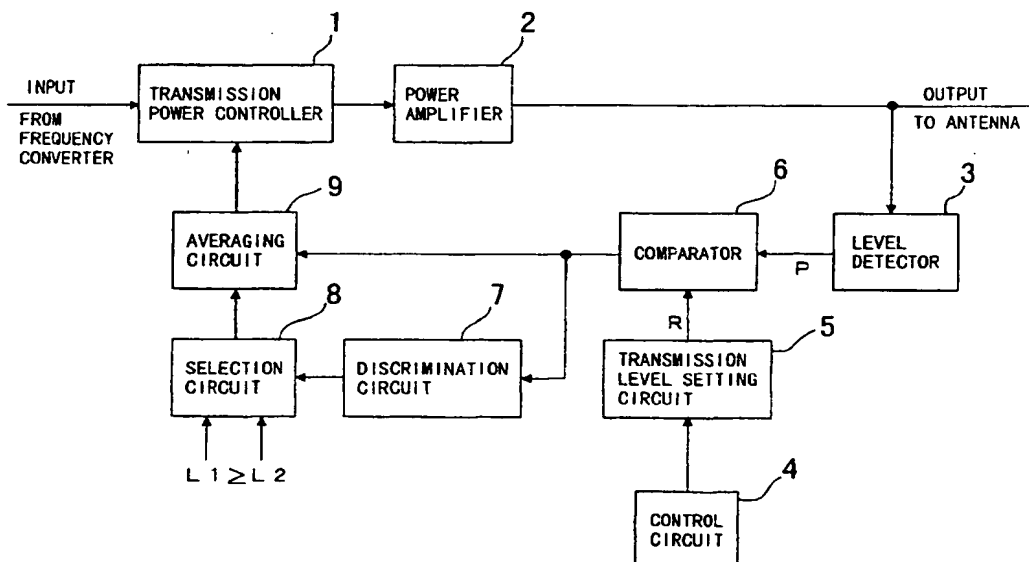
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(54) Method and apparatus for controlling the transmission power in a mobile radio satellite communication system

(57) A transmission power control apparatus includes a transmission power control loop (1, 2, 3, 6, 9) provided in one of a gateway station (12) and a terminal/mobile station (13) for controlling a transmission power of the station. The transmission level during transmission is monitored and compared with a preset transmission level to change over an average time for sampling of the error between the transmission levels to vary the response speed of the transmission power control loop

(1, 2, 3, 6, 9). When the channel to be currently used is to be changed over from a signalling channel (15) to a communication channel (16), the transmission power is controlled so that synchronization maintenance is achieved at the receiving end. But, when the channel is to be changed over from the communication channel (16) to the signalling channel (15), the transmission power is controlled rapidly to a standard level so that synchronization acquisition or data transmission is achieved with minimum trouble.

FIG. 1



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## Description

The present invention relates to a method and apparatus for use in controlling the transmission power in a mobile radio satellite communication system. A particular transmission power control method and apparatus for a mobile radio satellite communication system to be described below, by way of example in illustration of the invention, controls the transmission power based on received transmission power control information, particularly when a channel is switched.

Previously proposed arrangements, which it is believed will be helpful in understanding the invention, will now be described with reference to Figs. 3 to 5 of the accompanying drawings, in which:-

Fig. 3 is a block schematic diagram showing the basic arrangement of a mobile radio satellite communication system,

Fig. 4 is a block schematic diagram showing the transmission section of a gateway station and a terminal/mobile station of the mobile radio satellite communication system shown in Fig. 3, and

Fig. 5 is a time chart illustrating the variation in the transmission power using the transmission power control apparatus of Fig. 3.

A satellite communication system which effects the channel access of a single channel per carrier (SCPC)/frequency division multiple access (FDMA) system based on a demand assignment will be described first. Referring to Fig. 3, there is shown a satellite communication system of the type mentioned which normally includes a network control station 11, which manages and controls the communications system, gateway stations 12 each connected to public switched telephone networks (PSTN), or private telephone networks, terminals and mobile stations (hereinafter referred to as terminals/mobile stations) 13, through which users access the satellite communications network, and a communication satellite 14.

The network control station 11 supervises the entire network and successively transmits channel signalling information by time division multiplex (TDM) communication using a forward link (also called an outbound link). The TDM communication includes information regarding an incoming call and the channel communication used. Each of the gateway stations 12 and the terminal/mobile stations 13 receives information transmitted thereto by the time division multiplex communication and effects a call request and responds to an incoming call based on the received information using a return link (inbound). The return link is used for the transmission of a call request and an incoming call response burst signal transmitted from each of the gateway stations 12 and the terminal/mobile stations 13 in a predetermined time slot, in accordance with the line information of the time division multiplex communication in a time division multiple access (TDMA).

If the network control station 11 receives a call request and an incoming call response signal transmitted from one of the gateway stations 12 and one of the terminal/mobile stations 13 (including an indirect case wherein a terminal or a mobile station transmits a call request to a gateway station and then the gateway station transmits a channel assignment request), then it informs the gateway station 12 and the terminal/mobile station 13 of an available communication channel over a signalling channel 15. Then, when the gateway station 12 and the terminal/mobile station 13 receive the designated communication channel, they set the channel so that a communication channel 16 is thereafter used in place of the signalling channel 15. Then, through a predetermined sequence, the terminal/mobile station 13 is connected to a PSTN or private switched network (PSTN)/private switched network 17) through the communication satellite 14 and the gateway station 12.

The signalling channel 15, which carries control information in such a sequence of channel connection operations as is described above, communicates the control information, normally using a prescribed maximum transmission level as a standard level, so that a call connection can be effected stably, even in a geographical condition in which the elevation angle is small (which is the most critical communication condition in call connection), in order to ensure a high degree of reliability of the communication system. After the changeover to a communication channel, the transmission level is adjusted so as to minimize any interference with another communication channel and allow the most efficient utilization of the power of the satellite. Further, in a mobile terminal which is driven by a battery, the power dissipation is minimized by such transmission level control to allow utilization for a long time.

The transmission powers of the gateway station 12 and the terminal/mobile station 13 of the communication system described above are each controlled by an apparatus such as is shown in Fig. 4.

Referring to Fig. 4, the apparatus shown includes a transmission power controller 1 for controlling the transmission power of a modulation signal frequency converted by a frequency converter not shown, a power amplifier 2 for amplifying the power of an output of the transmission power controller 1 to a predetermined transmission power, and outputting the amplified power signal to an antenna not shown, a level detector 3 for detecting the output level of the power amplifier 2, a comparator 6 for comparing the transmission level detected by the level detector 3 with a preset transmission reference level to obtain any error in the level and an averaging circuit 9 for averaging the error of the level from the comparator 6 and controlling the transmission power controller 1 with the averaged level error.

In operation, upon transmission over the signalling channel 15, the transmission level is set to the maximum standard transmission level, and the level of a transmission signal detected by the level detector 3 during transmission is compared with the preset transmission level value by the comparator 6 to obtain a level error. The level error of the detected level from the preset transmission reference level is averaged by the averaging circuit 9. Then, the transmission power is controlled so that, if the detected transmission signal level is higher than the preset transmission level value, then the transmission signal level may be decreased, but if the detected transmission signal level is lower than the preset transmission level, then the decrease of the transmission signal level may be decreased.

A channel is assigned in response to the channel assignment request in the signalling channel 15, and communication via the communication channel 16 is started. After the communication via the communication channel 16 has been started, the terminal/mobile station 13 and the gateway station 12 individually measure the levels of the received signals, set optimum transmission levels for the operation of the system and control the transmission powers thereof. Such a control is disclosed, for example, in the specification of Japanese Patent Laid-Open Application No. Heisei 8-237194. The transmission power control for the signalling channel 15 is performed in a similar manner to that for the communication channel 16, except that the preset transmission level values set for the comparators are different.

After the communication over the communication channel 16 has been completed, communication via the signalling channel 15 is enabled again. The transmission signal level is then set to the standard maximum transmission level, but it is controlled, upon transmission, to the predetermined transmission power by the operation described above.

While the transmission level is controlled in accordance with the procedure described above, so that possible interference between communication channels may be minimized and the power of the satellite may be utilized more efficiently, if the control step of the transmission level becomes large, there is experienced the following problem, which will be described with reference to Fig. 5 in which there are illustrated the transmission powers when a channel to be used is changed over between a signalling channel and a communication channel.

When, after communication over the communication channel has been started the transmission level of a station is to be decreased to a lower level, because the received level of the other station is sufficiently high, it is varied at a rate which can be followed up sufficiently so that synchronization can be maintained on the reception side against a variation in amplitude or phase. When the communication is terminated while the transmission power is controlled stably at the lowest transmission level and then communication over the signalling channel is enabled again, the transmission level is set to the standard highest transmission level in preparation for next transmission. When a control signal burst, such as a call request or an incoming call response, is to be transmitted subsequently over the signalling channel, the top of the burst is transmitted with the level controlled to the lower level over the communication channel and the burst is started while the transmission level is controlled so as to increase it to the highest level.

Therefore, it sometimes occurs that a power to noise power ratio of a carrier required by the communication system is not obtained and this can give rise to a problem in synchronization acquisition or in data transmission. Particularly, a top portion of a burst includes a training sequence and/or a unique word for carrier synchronization and/or clock synchronization and plays an important role in the transmission of a data part.

If, on the contrary, the transmission level control response over the signalling channel is made faster, so as to allow quick convergence to a predetermined transmission level, in order to eliminate the problem described above, then the problem may possibly occur that, when the transmission level is controlled after the reception level information of the other station is received over the communication channel, the frame synchronization of the other station cannot be maintained, or that the transmission power control becomes unstable. Such problems are significant particularly where the transmission level control step is large.

It is a feature of a transmission power control method and apparatus for a mobile radio satellite communication system to be described below, by way of example in illustration of the invention, that frame synchronization maintenance and synchronization acquisition of a receiving station and optimum transmission power control are made possible with a simple construction which does not require any complicated control.

In a particular arrangement to be described below, by way of example in illustration of the present invention, a method for the control of the transmission power in a mobile radio satellite communication system having a gateway station and a terminal/mobile station to provide communication by demand assignment using a signalling channel and a communication channel via a communication satellite, includes the step of controlling a transmission power control loop provided in any of the gateway station and the terminal/mobile station for controlling the transmission power of the gateway station or of terminal/mobile station so that, when a transmission channel for current use is to be changed over from the signalling channel to the communication channel, the response speed of the transmission power control loop is set to a comparatively low value, but when the transmission channel for current use is to be changed over from the communication channel to the signalling channel, the response speed of the transmission power control loop is set to a comparatively high value.

In one transmission power control apparatus for a mobile radio satellite communication system to be described below, by way of example, in illustration of the invention where a gateway station and a terminal/mobile station effect communication by assignment on demand using a signalling channel and a communication channel via a communi-

cation satellite, there are a transmission power control loop in each of the gateway station and the terminal/mobile station for controlling the transmission power of the gateway station or the terminal/mobile station, and control means for controlling the transmission power control loop of each of the gateway station and the terminal/mobile station so that, when a transmission channel for current use is to be changed over from the signalling channel to the communication channel, the response speed of the transmission power control loop is set to a comparatively low value, but when the transmission channel for current use is to be changed over from the communication channel to the signalling channel, the response speed of the transmission power control loop is set to a comparatively high value.

The transmission power control apparatus may be constructed such that the signalling channel is used for communication with the gateway station, the terminal/mobile station and a network control station, and the transmission power levels of the gateway station and the terminal/mobile station are set to the highest level. Further, the transmission power control apparatus may be constructed such that the communication channel is used for communication between the gateway station and the terminal/mobile station, and the transmission power levels of the gateway station and the terminal/mobile station are set to an optimum transmission level based on a reception level detected by one and transmitted to the other of the gateway station and the terminal/mobile station.

The transmission power control loop may include a transmission power controller for receiving an input signal and controlling the transmission level for the signal in accordance with a control signal, comparison means being provided for detecting the transmission level of an output from the transmission power controller and the detected transmission level being compared with a preset transmission level to detect an error in the level of the detected transmission level from a preset transmission level, averaging means being provided for controlling the response speed of the transmission power control loop based on the error of the level detected by the comparison means, and means being provided for receiving an output of the averaging means and producing a control signal controlling the transmission power controller so that the error level may be minimised.

The averaging means may include discrimination means for discriminating the polarity of the error level, conversion means for converting the error level from an analog signal into a digital signal for a period corresponding to a predetermined sample number, selection means for selecting the predetermined sampling number from within a plurality of average sample numbers based on an output of the discrimination means, and control means for averaging a number of error levels, successively output after each fixed interval of time from the comparison means, which is equal to the predetermined sample number selected by the selection means to obtain a digital signal to be used as the control signal for the transmission power controller.

Alternatively the averaging means may include discrimination means for discriminating the polarity of the error level, a filter for receiving the error level, the filter having a cutoff frequency which is variable in response to a control signal, selection means for selecting the cutoff frequency of the filter based on an output of the discrimination means, and control means for controlling the transmission power controller through the filter with the cutoff frequency selected by the selection means.

Another arrangement to be described below by way of example in illustration of the present invention, includes transmission power control apparatus for a mobile radio satellite communication system having a gateway station and a terminal/mobile station in which communication is effected by assignment on demand using a signalling channel and a communication channel via a communication satellite, there being transmission power control apparatus in each of the gateway station and the terminal/mobile station, and the transmission power control apparatus including a transmission power controller for receiving an input signal and controlling a transmission level for the signal in accordance with a control signal, a power amplifier for amplifying the output power of the transmission power controller to a predetermined transmission level, a level detector for detecting the transmission level of the output of the power amplifier, a control circuit for analyzing received information transmitted from the other of the gateway station and the terminal/mobile station to set an optimum transmission level, a comparison circuit for comparing the transmission level detected by the level detector with an optimum transmission level, a discrimination circuit for discriminating the polarity of the output signal of the comparison circuit and outputting a selection control signal for an average sample number or average time, a selection circuit for selecting an average sample number in accordance with the selection signal from the discrimination circuit, and an averaging circuit for averaging a number of error levels successively output after each fixed interval of time from the comparison circuit which is equal to the average sample number designated by the selection circuit to obtain a digital signal to be used as the control signal for the transmission power controller.

Yet another transmission power control apparatus for a mobile radio satellite communication system, to be described below, by way of example in illustration of the invention wherein a gateway station and a terminal/mobile station effect communication by assignment on demand, using a signalling channel and a communication channel via a communication satellite, the transmission power control apparatus being provided in each of a transmission section of the gateway station and the terminal/mobile station, includes a transmission power controller for receiving an input signal and controlling a transmission level for the signal in accordance with a control signal, a power amplifier for amplifying the power of an output of the transmission power controller to a predetermined transmission level, a level detector for detecting the transmission level of an output of the power amplifier, a control circuit for analyzing the reception infor-

mation transmitted from the other one of the gateway station and the terminal/mobile station to set an optimum transmission level, a comparison circuit for comparing the transmission level detected by the level detector with the optimum transmission level, a discrimination circuit for discriminating the polarity of an output signal of the comparison circuit and outputting a selection signal for selecting a filter cutoff frequency, a selection circuit for selecting a filter cutoff frequency in response to the selection signal from the discrimination circuit, and an averaging circuit including a filter of a variable cutoff frequency for averaging a number of error levels successively output after each fixed interval of time from the comparison circuit which corresponds to the cutoff frequency designated by the selection circuit to obtain a digital signal to be used as the control signal for the transmission power controller.

With a transmission power control method and apparatus such as one of those described above, the transmission level during transmission is monitored and the monitored transmission level is compared with a preset transmission level to change over the average time for sampling the error between the transmission levels to vary the response speed with a simple circuit arrangement which does not require a complicated control. Consequently, when the channel for current use is to be changed over from a signalling channel to a communication channel, the transmission power is controlled so that there is no trouble with synchronization at the reception side. Furthermore, when the channel for current use is to be changed over from the communication channel to the signalling channel, the transmission power is controlled rapidly to a standard level so that there is no trouble in synchronization acquisition or data transmission.

The following description and Figs. 1 and 2 of the accompanying drawings, disclose, by means of an example, the invention which is characterised in the appended claims, whose terms determine the extent of the protection conferred hereby.

In the drawings:-

Fig. 1 is a block schematic diagram of a transmission section of a gateway station and a terminal/mobile station to which a transmission power control apparatus is applied, and

Fig. 2 is a time chart illustrating a variation of the transmission power by the transmission power control apparatus shown in Fig. 1.

Referring to Fig. 1, there is shown transmission power control apparatus for incorporation in each of a gateway station and a terminal/mobile station, such as the gateway stations 12 and the terminal/mobile stations 13 described above with reference to Fig. 3.

The transmission power control apparatus of Fig. 1 may be incorporated in a transmission section of each of gateway stations and terminal/mobile stations of a satellite communication system which effects the call connection of a single channel per carrier (SCPC) or a frequency division multiple access (FDMA) system based on assignment on demand, and includes a transmission power controller 1 for controlling the transmission level of a modulation signal frequency converted by a frequency converter (not shown), a power amplifier 2 for power amplifying an output of the transmission power controller 1 to a predetermined transmission level and outputting the power amplified signal to an antenna not shown, a level detector 3 for detecting the output level of the power amplifier 2, a control circuit 4 for analyzing reception information transmitted to the station from another station and setting an optimum transmission level, a transmission level setting circuit 5 for outputting a reference signal of the transmission level set by the control circuit 4, a comparator 6 for comparing the transmission level detected by the level detector 3 with the reference signal of the preset transmission level, a discrimination circuit 7 for discriminating the polarity of a signal output from the comparator 6 and outputting a selection control signal of an average sample number (average time), a selection circuit 8 for selecting an average sample number in response to the selection control signal from the discrimination circuit 7, and an averaging circuit 9 for averaging a number of error levels successively output after each fixed interval of time from the comparator 6 designated by the selection circuit 8 to obtain a digital signal to be used as a control signal for the transmission power controller 1.

The averaging circuit 9 may be formed from an analog to digital (A/D) converter which receives an error component (analog signal) output from the comparator 6 and converts the error component into a digital signal with a predetermined sampling number.

In this instance, the predetermined sample number can be selected from between two average sample numbers L1 and L2 in response to an output of the discrimination circuit 7, and a digital signal which is produced on the basis of the selected average sample number is used to control the transmission level of a modulation signal mentioned above by the transmission power controller 1.

The operation of the transmission power control apparatus shown in Fig. 1 will now be described.

Transmission data to be transmitted first undergo coding processing, such as error correction, differential operation and scrambling and are then digitally modulated, whereafter they are converted into a signal at a radio frequency by a frequency converter not shown. The transmission level of the signal is adjusted by the transmission power controller 1, and then the signal is power amplified to a predetermined level by the power amplifier 2. The thus power amplified signal is sent out from the antenna (not shown) through a duplexer (not shown). Further, the transmission level of the

signal being transmitted is monitored by the level detector 3.

The level at which the signal is to be transmitted is set at the transmission level setting circuit 5 by the control circuit 4, and the transmission level setting circuit 5 produces a reference signal corresponding to one of the transmission levels.

The transmission level  $P$  detected by the level detector 3 and the reference signal  $R$  of the thus set transmission level are compared with each other by the comparator 6 to detect an error ( $P - R$ ) of the transmission level  $P$  from the transmission level  $R$ . The error is averaged by the averaging circuit 9 while the polarity of the error ( $P - R$ ) is discriminated by the discrimination circuit 7, and the average sample number of the averaging circuit 9 is controlled based on a result of the discrimination. Here, the two average sample numbers  $L1$  and  $L2$  are prepared in advance by the selection circuit 8, and one of the average sample numbers  $L1$  and  $L2$  is selectively determined based on the result of the discrimination of the discrimination circuit 7. The transmission power controller 1 is controlled by means of the result of the averaging of the error with the selected average sample number. Consequently, a transmission power control loop is formed from the elements 1, 2, 3, 6, 7, 8 and 9 described above.

If the average sample number of the averaging circuit 9 is set to a comparatively high value, then the response speed is comparatively low, and the control system operates stably, but if a comparatively small average sample number is selected, then a comparatively high response speed is obtained, and convergence to the preset level is reached comparatively quickly.

If the detected transmission level  $P$  is lower than the preset transmission level  $R$  as seen from Table 1 below, that is, when  $P - R \leq 0$ , the error is averaged by the comparatively large average sample number  $L1$ , but if the detected transmission level  $P$  is not higher than the preset transmission level  $R$ , that is, when  $P - R > 0$ , the error is averaged with the comparatively small average sample number  $L2$  ( $L1 > L2$ ).

Table 1.

#### Control Logic in Average Sample Number Selection

Condition	Used average sample number
Detection level $P <$ Preset transmission level $R$	$L1$
Detection level $P \geq$ Preset transmission level $R$	$L2$

$$L1 > L2$$

By means of the control in accordance with the logic, the transmission channel is changed over from the signalling channel 15 to the communication channel 16 such that, when the transmission level is to be changed over from the maximum transmission level, which is a standard level, to the designated low power level, until after the transmission level is stabilized at the preset level to effect stabilized transmission, the transmission level remains higher than the preset level, and consequently, the error from the preset level is averaged with the comparatively large average sample number  $L1$ . The average sample number  $L1$  is then set so that synchronization maintenance on the reception side can be performed without any trouble with the response speed.

Then, when the transmission channel is changed over from the communication channel to the signalling channel and the transmission level is to be changed over from the low power level to the maximum transmission level, which is a standard level, since the transmission level remains lower than the preset level until after it converges to the maximum transmission level, the error from the preset level is averaged with the comparatively low average sample

number L2. The convergence to the preset transmission level is thus accelerated by the comparatively low average sample number L2, so that the transmission power is controlled to allow transmission with a predetermined level so that call connection can be performed stably even in a communication condition which is the most severe for a call connection.

The averaging circuit 9 described hereinabove need not be formed from an analog to digital converter, but may be formed from some other element having an equivalent function. For example, the averaging circuit 9 may be formed from a low-pass filter whose cutoff frequency can be controlled from the outside. In this instance, the output of the discrimination circuit 7 is input to the selection circuit 8, by which the cutoff frequency of the filter is controlled.

In particular, transmission power control is performed by the control of the selection circuit 8 such that, where  $P \geq R$ , the cutoff frequency is set to a comparatively low value to make the response speed low, but where  $P < R$ , the cutoff frequency is set to a comparatively high value to make the response speed high. By the use of transmission power control, the problem experienced upon changing over from a control circuit to a communication channel can be minimised.

While a preferred embodiment illustrative of the present invention has been described by way of example using specific terms, it will be understood that changes and variations therein and other embodiments may be conceived within the scope of the protection sought by the following claims.

### Claims

1. A method of transmission power control for use in a mobile radio satellite communication system wherein a gateway station (12) and a terminal/mobile station (13) effect communication by assignment on demand using a signalling channel (15) and a communication channel (16) via a communication satellite (14), characterised in that a transmission power control loop (1, 2, 3, 6, 9), provided in one of the gateway station (12) and the terminal/mobile station (13) for controlling the transmission power of the gateway station (12) or the terminal/mobile station (13), is controlled so that, when a transmission channel for current use is to be changed over from the signalling channel (15) to the communication channel (16), a response speed of the transmission power control loop (1, 2, 3, 6, 9) is set to a lower value, but when the transmission channel for current use is to be changed over from the communication channel (16) to the signalling channel (15), the response speed of the transmission power control loop (1, 2, 3, 6, 9) is set to a higher value.
2. A transmission power control apparatus for use in a mobile radio satellite communication system wherein a gateway station (12) and a terminal/mobile station (13) effect communication by assignment on demand using a signalling channel (15) and a communication channel (16) via a communication satellite (14), characterized in that it includes a transmission power control loop (1, 2, 3, 6, 9) provided in one of the gateway station (12) and the terminal/mobile station (13) for controlling the transmission power of the gateway station (12) or the terminal/mobile station (13), and control means (7, 8) for controlling the transmission power control loop (1, 2, 3, 6, 9) of the gateway station (12) or the terminal/mobile station (13) so that, when a transmission channel for current use is to be changed over from the signalling channel (15) to the communication channel (16), the response speed of the transmission power control loop (1, 2, 3, 6, 9) is set to a lower value, but when the transmission channel for current use is to be changed over from the communication channel (16) to the signalling channel (15), the response speed of the transmission power control loop (1, 2, 3, 6, 9) is set to a higher value.
3. A transmission power control apparatus for a mobile radio satellite communication system as claimed in claim 2, in which the signalling channel (15) is used for communication with the gateway station (12), the terminal/mobile station (13) and a network control station (11), and the transmission power levels of the gateway station (12) and the terminal/mobile station (13) are set to the highest level.
4. A transmission power control apparatus for a mobile radio satellite communication system as claimed in claim 2, in which the communication channel (16) is used for communication between the gateway station (12) and the terminal/mobile station (13), and the transmission power levels of the gateway station (12) and the terminal/mobile station (13) are set to an optimum transmission level based on a received level detected by one and transmitted to the other one of the gateway station (12) and the terminal/mobile station (13).
5. A transmission power control apparatus for a mobile radio satellite communication system as claimed in claim 2, in which the transmission power control loop (1, 2, 3, 6, 9) includes a transmission power controller (1) for receiving an input signal and controlling the transmission level for the signal in accordance with a control signal, comparison means (6) for detecting a transmission level of an output of the transmission power controller (1) and comparing

the detected transmission level with a preset transmission level to detect the level of an error between the detected transmission level and the preset transmission level, averaging means (9) for controlling the response speed of the transmission power control loop (1, 2, 3, 6, 9) based on the level of the error detected by the comparison means (6), and means (7, 8, 9) for receiving the output of the averaging means (9) and producing a control signal controlling the transmission power controller (1) so that the level of the error may be minimized.

6. A transmission power control apparatus for a mobile radio satellite communication system as claimed in claim 5, in which the averaging means (9) includes discrimination means (7) for discriminating the polarity of the error level, conversion means (9) for converting the error level from an analog signal into a digital signal for a period corresponding to a predetermined sample number, selection means (8) for selecting the predetermined sampling number from within a plurality of average sample numbers based on an output of the discrimination means (7), and control means (9) for averaging a number of error levels successively output after each fixed interval of time from the comparison means (6) which is equal to the predetermined sample number selected by the selection means (8) to obtain a digital signal to be used as the control signal for the transmission power controller (1).
7. A transmission power control apparatus for a mobile radio satellite communication system as claimed in claim 5, in which the averaging means (9) includes discrimination means (7) for discriminating the polarity of the error level, a filter (9) for receiving the error level, the filter having a cutoff frequency which is variable in response to a control signal, selection means (8) for selecting the cutoff frequency of the filter based on an output of the discrimination means (7), and control means (9) for controlling the transmission power controller (1) through the filter (9) with the cutoff frequency selected by the selection means (8).
8. A transmission power control apparatus for a mobile radio satellite communication system in which a gateway station (12) and a terminal/mobile station (13) effect communication by assignment on demand using a signalling channel (15) and a communication channel (16) via a communication satellite (14), the transmission power control apparatus being provided in one of the gateway station (12) and the terminal/mobile station (13), characterised in that the transmission power control apparatus includes a transmission power controller (1) for receiving an input signal and controlling the transmission level for the signal in accordance with a control signal, a power amplifier (2) for amplifying the power of an output of the transmission power controller (1) to a predetermined transmission level, a level detector (3) for detecting the transmission level of an output of the power amplifier (2), a control circuit (4) for analyzing received information transmitted from the other one of the gateway station (12) and the terminal/mobile station (13) to set an optimum transmission level, a comparison circuit (6) for comparing the transmission level detected by the level detector (3) with the optimum transmission level, a discrimination circuit (7) for discriminating the polarity of an output signal of the comparison circuit (6) and outputting a selection control signal for an average sample number or average time, a selection circuit (8) for selecting an average sample number in accordance with the selection signal from the discrimination circuit (7), and an averaging circuit (9) for averaging a number of error levels successively output after each fixed interval of time from the comparison circuit (6) which is equal to the average sample number designated by the selection circuit (8) to obtain a digital signal to be used as the control signal for the transmission power controller (1).
9. A transmission power control apparatus for a mobile radio satellite communication system in which a gateway station (12) and a terminal/mobile station (13) effect communication by assignment on demand using a signalling channel (15) and a communication channel (16) via a communication satellite (14), the transmission power control apparatus being provided in one of a transmission section of the gateway station (12) and of the terminal/mobile station (13), the transmission power control apparatus being characterized in that it includes a transmission power controller (1) for receiving an input signal and controlling the transmission level for the signal in accordance with a control signal, a power amplifier (2) for power amplifying an output of the transmission power controller (1) to a predetermined transmission level, a level detector (3) for detecting a transmission level of the output of the power amplifier (2), a control circuit (4) for analyzing received information transmitted from the other one of the gateway station (12) and the terminal/mobile station (13) to set an optimum transmission level, a comparison circuit (6) for comparing the transmission level detected by the level detector (3) with the optimum transmission level, a discrimination circuit (7) for discriminating the polarity of an output signal of the comparison circuit (6) and outputting a selection signal for selecting a filter cutoff frequency, a selection circuit (8) for selecting a filter cutoff frequency in response to the selection signal from the discrimination circuit (7), and an averaging circuit (9) including a filter of a variable cutoff frequency for averaging a number of error levels successively output after each fixed interval of time from the comparison circuit (6) which corresponds to the cutoff frequency designated by the selection circuit (8) to obtain a digital signal to be used as the control signal for the transmission power controller (1).

FIG. 1

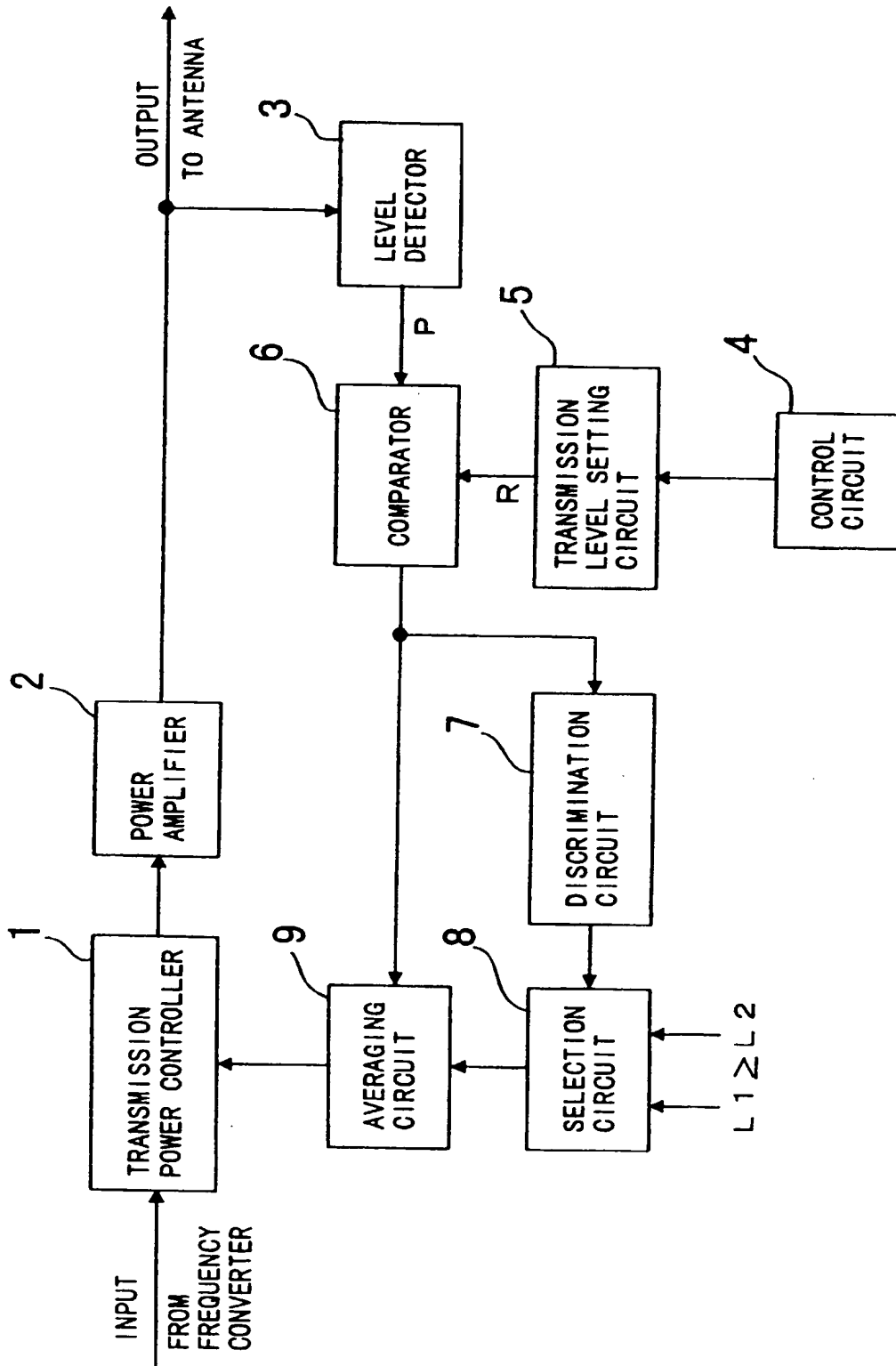


FIG. 2

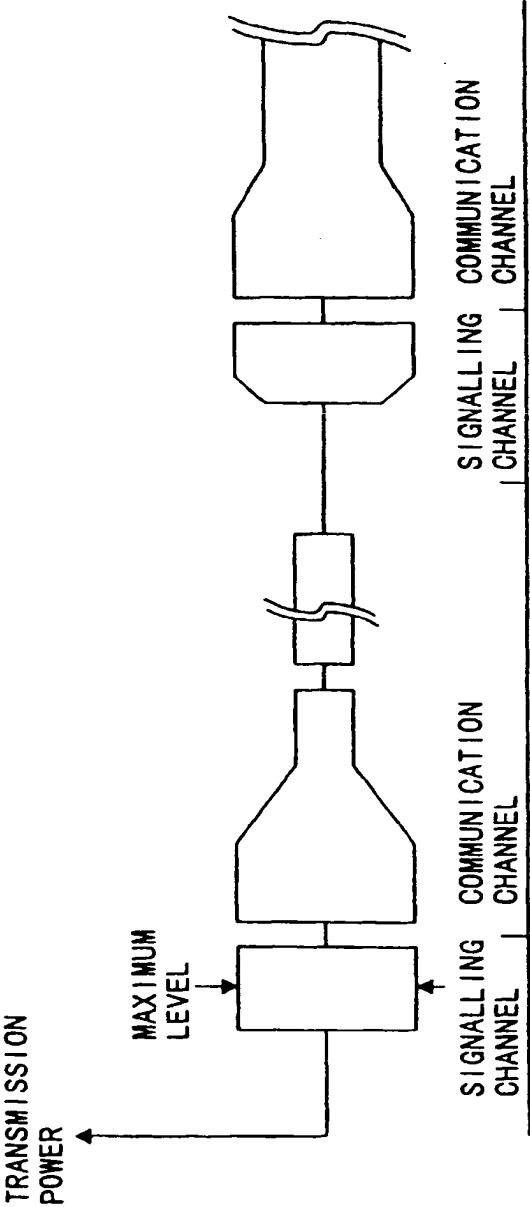


FIG. 3

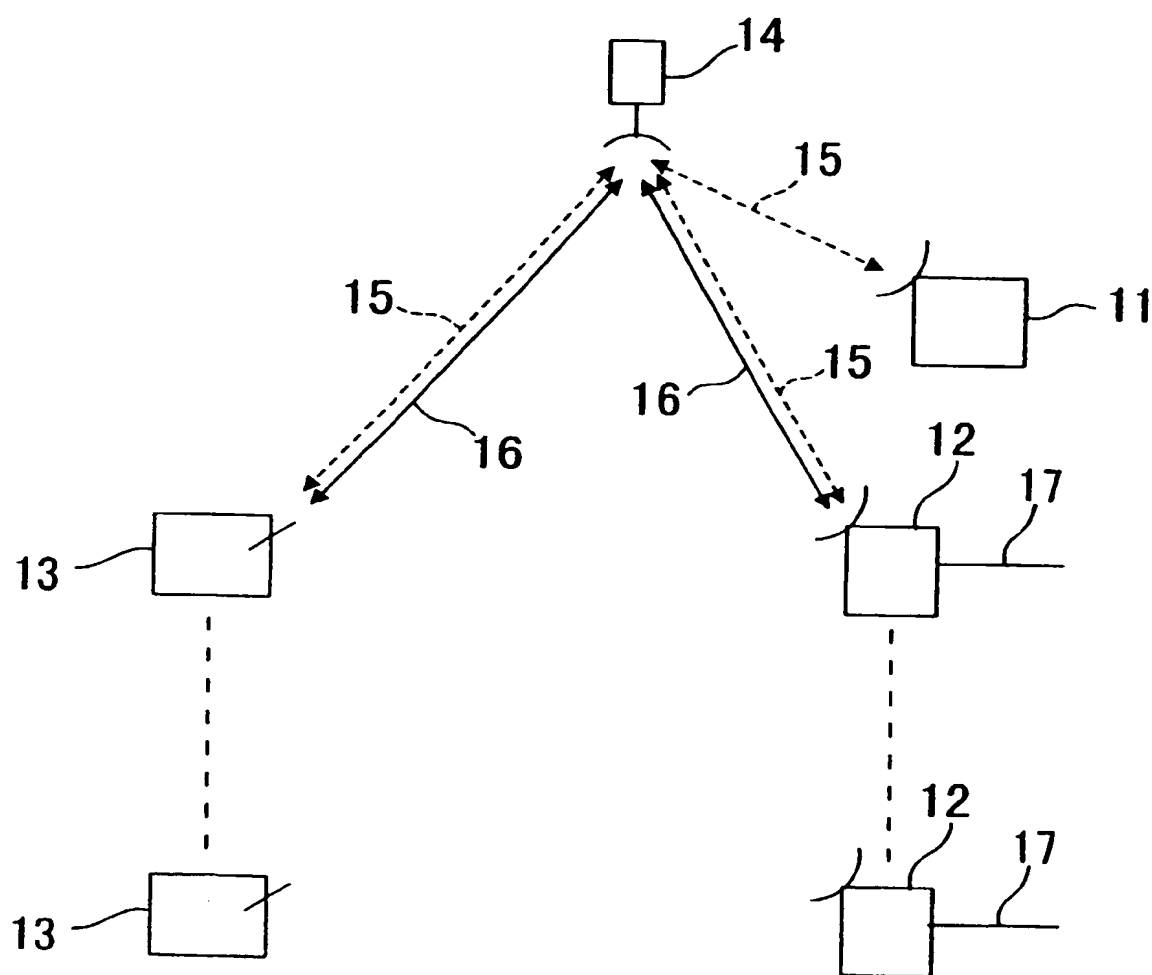


FIG. 4

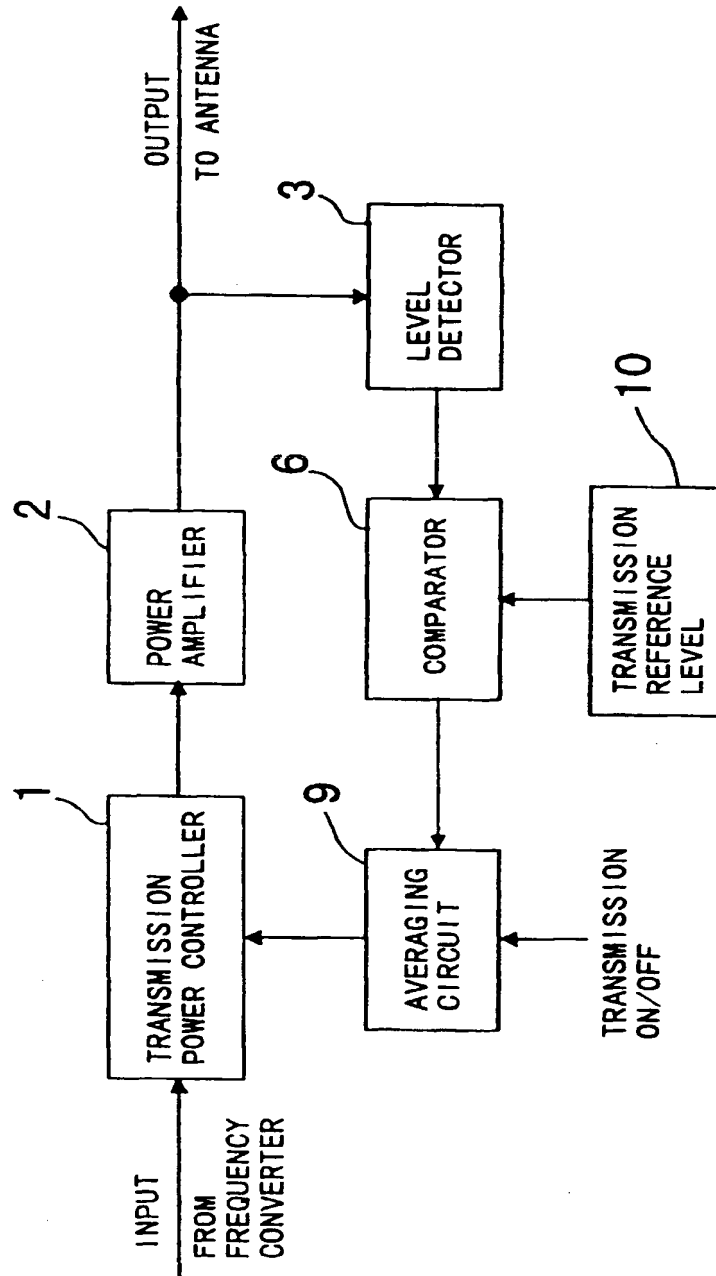
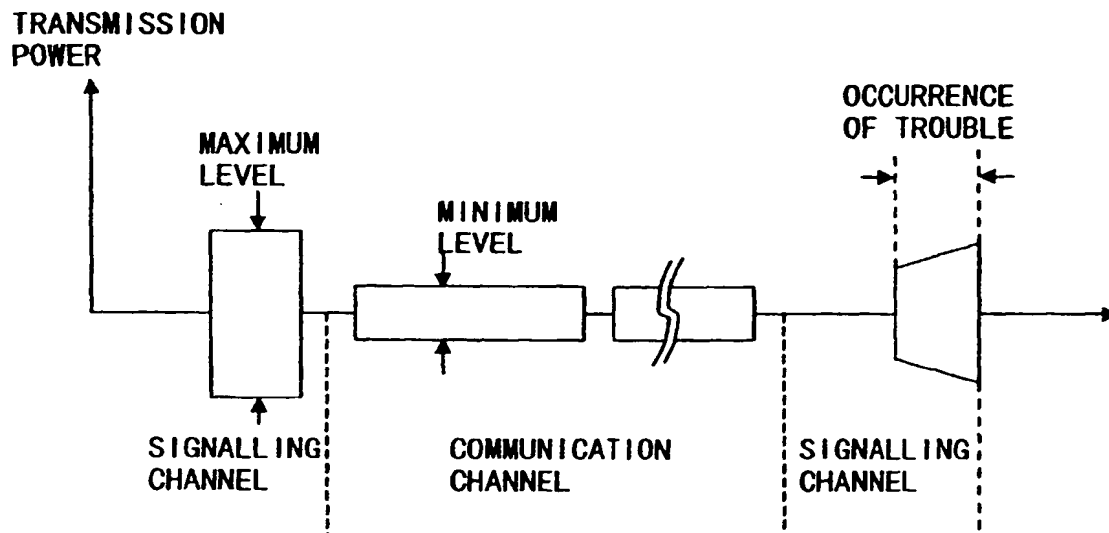


FIG. 5



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(71) Applicant: **NEC CORPORATION**  
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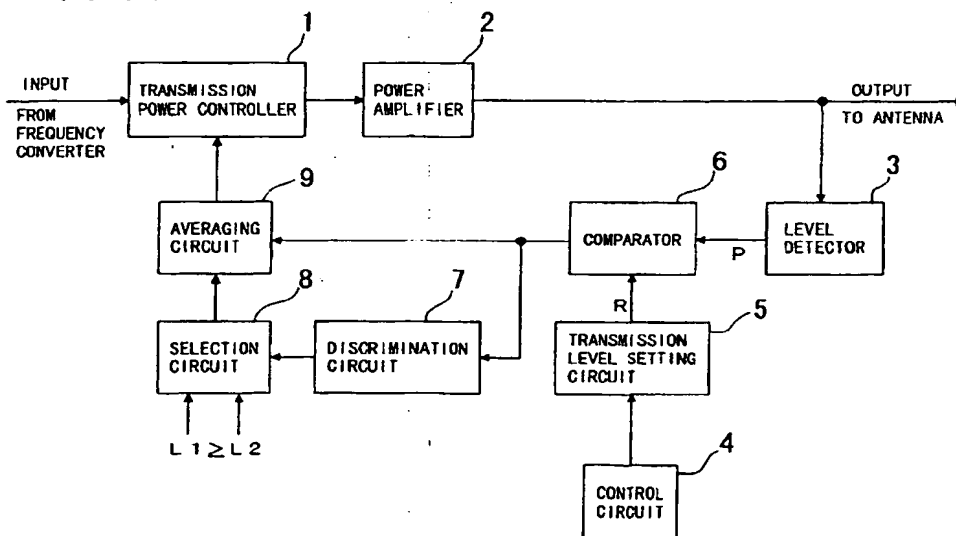
(74) Representative: **W.P. THOMPSON & CO.**  
**55 Drury Lane**  
**London WC2B 5SQ (GB)**

(54) **Method and apparatus for controlling the transmission power in a mobile radio satellite communication system**

(57) A transmission power control apparatus includes a transmission power control loop (1, 2, 3, 6, 9) provided in one of a gateway station (12) and a terminal/mobile station (13) for controlling a transmission power of the station. The transmission level during transmission is monitored and compared with a preset transmission level to change over an average time for sampling of the error between the transmission levels to vary the response speed of the transmission power control loop

(1, 2, 3, 6, 9). When the channel to be currently used is to be changed over from a signalling channel (15) to a communication channel (16), the transmission power is controlled so that synchronization maintenance is achieved at the receiving end. But, when the channel is to be changed over from the communication channel (16) to the signalling channel (15), the transmission power is controlled rapidly to a standard level so that synchronization acquisition or data transmission is achieved with minimum trouble.

**FIG. 1**





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 98 30 4223

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A	JP 05 291852 A (TOSHIBA CORP;OTHERS: 01) 5 November 1993 (1993-11-05) * the whole document * -----	1,2,8,9	
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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 25 March 2003	Examiner Lauri, L
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... &amp; : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 30 4223

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The members are as contained in the European Patent Office EDP file on  
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25-03-2003

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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